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Claims:

1. A process for inducing homogeneous precipitation of a metal oxide, wherein said metal is capable of existing in at least two cationic oxidation states, which process comprises the steps of:

(i) providing an aqueous solution of a metal in a lower cationic oxidation state, and

(ii) adding an oxidant capable of oxidizing said metal to a higher cationic oxidation state under conditions such that the mixing of said aqueous solution and said oxidant is substantially complete before precipitation of an oxide of said metal in its higher oxidation state occurs,

wherein the rate of oxidation is reduced by cooling the aqueous solution of said metal in a lower cationic oxidation state and/or the oxidant prior to mixing.

2. A process as claimed in claim 1, wherein the aqueous solution of said metal in a lower cationic oxidation state and the oxidant are cooled to a temperature in the range of from -10 to 10°C prior to mixing.

3. A process as claimed in claim 2, wherein the aqueous solution of said metal in a lower cationic oxidation state and the oxidant are cooled to a temperature in the range of from 0 to 5°C prior to mixing.

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4. A process as claimed in any one of the preceding claims, wherein the metal oxide which precipitates out of solution is a product of hydrolysis of the metal in

its higher cationic oxidation state.

5. A process as claimed in any one of the preceding claims, wherein the oxidant is added as an aqueous solution.

6. A process as claimed in any one of the preceding claims, wherein the metal is selected from Ce or Fe.

7. A process as claimed in any one of the preceding claims, wherein the aqueous solution of said metal in a lower cationic oxidation state comprises nitrate as a counter-ion.

8. A process as claimed in any one of the preceding claims, wherein the aqueous solution of said metal in a lower cationic oxidation state is of a concentration in the range of from 0.01 to 1.0 mol/1.

9. A process as claimed in any one of the preceding claims, wherein the aqueous solution of said metal in a lower cationic oxidation state is of a concentration of approximately 0.1 mol/1.

10. A process as claimed in any one of the preceding claims, wherein the oxidant comprises hydrogen peroxide.

11. A process as claimed in claim 10, wherein the metal salt or oxide has the general formula $M(OH)_{x-y}OOH_y$, wherein X is equal to the oxidation state of the metal cation M and $y \geq 1$.

12. A process as claimed in claim 10 or claim 11, wherein the metal in its lower oxidation state is Ce^{3+}, the metal in its higher oxidation state is Ce^{4+} and the metal oxide which precipitates has the general

formula $Ce(OH)_{4-y}OOH_y$ wherein $y \geq 1$.

13. A process as claimed in any one of the preceding claims, comprising the additional step of adding hydroxide ions to the reaction mixture so as to substantially complete the precipitation process.

14. A process as claimed in claim 13, wherein said hydroxide ions are provided by the addition of ammonium hydroxide.

15. A process as claimed in any one of the preceding claims, comprising the further step of isolating the precipitate.

16. A process as claimed in claim 15, comprising the further step of washing and drying the isolated precipitate.

17. A process for the precipitation of a weakly agglomerated nanocrystalline powder of a metal oxide, which process comprises the steps of:

(i) inducing homogeneous precipitation of said metal oxide by a process according to claim 13 or claim 14; and

(ii) isolating the precipitate.

18. A process as claimed in claim 17, which further comprises the step of subjecting the precipitate to hydrothermal treatment.

19. A process as claimed in claim 17 or claim 18 comprising the further step of washing and drying the precipitate.

20. A process as claimed in any one of claims 17 to 19, wherein said hydrothermal treatment is at a temperature of from 100 to 300°C.

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21. A process as claimed in any one of claims 17 to 20, wherein said hydrothermal treatment is at a temperature of approximately 180°C.

22. A metal oxide obtained by a process as claimed in any one of claims 1 to 16.

23. A weakly agglomerated nanocrystalline powder of a metal oxide produced according to a process as claimed in any one of claims 17 to 21.

24. A metal oxide as claimed in claim 22 or a weakly agglomerated nanocrystalline powder of a metal oxide as claimed in claim 23 having a mean particle size in the range of from 2 to 10 nm with a geometric standard deviation in the particle size less than or equal to 1.2.

25. A metal oxide as claimed in claim 22 or claim 24 or a weakly agglomerated nanocrystalline powder of a metal oxide as claimed in claim 23 or claim 24 having a mean particle size in the range of from 2 to 5 nm with a geometric standard deviation in the particle size less than or equal to 1.1.

26. A metal oxide as claimed in any one of claims 22, 24 or 26 or a weakly agglomerated nanocrystalline powder of a metal oxide as claimed in any one of claims 23, 24 or 25 which comprises cerium oxide.

27. A glass, a polishing medium for glass, a thin surface film, a phosphor, an oxygen storage material or catalyst material which has been manufactured by a

process which uses a weakly agglomerated nanocrystalline powder of a metal oxide as claimed in any one of claims 23, 24, 25 or 26.